2011

College of Engineering Magazine

University of Maine College of Engineering

Dana N. Humphrey
Dean, College of Engineering


COLLEGE OF ENGINEERING
Setting the course for deepwater offshore wind
1865 THE UNIVERSITY OF MAINE

ENGINEERING

innovating our economic future

ON THE COVER: University of Maine second-year structural engineering master's students Christa Miller-Shelley of Pine Plains, N.Y., and Garrett Luszczki of Augusta, Maine, stand in the soon-to-be-completed Offshore Wind Laboratory, a 37,000-square-foot addition to AEWC Advanced Structures & Composites Center. Behind them is the 15-foot-square mounting plate on the wind blade test fixture.

facebook.com/umaine.engineering

engineering.umaine.edu

Message from the Dean

Welcome to the annual edition of the UMaine College of Engineering magazine, featuring stories of our faculty and students carrying on the proud, 147-year legacy of engineering excellence that remains Maine's premier source for engineering education and research.

Education, innovation, research and economic development — they are what we do. Our faculty has generated more than $13 million in research funding in the last year. We are conducting game-changing work resulting in job creation and innovation in offshore wind, tidal energy, smart grid, robotics, biofuels, sensors and nanoscale engineering.

This fall, UMaine engineering is setting records in enrollment with more than 400 incoming students. Twenty-four percent of those students are women, compared to a typical average of 15 percent. This is due in part to our Girls Engineering Maine program that brings middle school girls to campus for a day of hands-on activities. Those enrollment numbers are headed in the right direction; however, it will take this class and many more to maintain and grow Maine's engineering workforce. In fact, Maine would need to at least double the number of engineering graduates to reach the national average. For the sake of the state and national economies, we must continue to make progress in this critical area.

As we look ahead, we continue to build opportunities for engineering education through the Maine Advanced Technology & Engineering Center (MATEC). This fall, we are offering several online courses tailored to professional engineers, including reliability and aeronautical engineering. In addition, a University of Maine System grant will allow us to offer the first two years of undergraduate engineering education at MATEC starting in fall 2012.

Whether you look at engineering through our graduates, our cutting-edge research or our impact on manufacturing and engineering in the state, one thing is clear: UMaine engineering is the engine of economic growth in Maine and beyond.

Dana N. Humphrey
Dean, College of Engineering

Modeling Maine's offshore options

DeepCwind and Department of Energy focus on data collection

This past spring, the 1:50-scale turbine designed by AEWC researchers was tested in Castine Harbor prior to sending it to MARIN for use on the three platforms being tested.

A team of student researchers and engineers from the University of Maine's AEWC Advanced Structures & Composites Center traveled to the Maritime Research Institute Netherlands (MARIN) this spring to test 1:50-scale, or approximately 10-foot, floating wind turbine models against simulated wind and waves.

The goal was to collect data that will refine and validate numerical models developed by the Department of Energy's National Renewable Energy Laboratory (NREL), which is working with UMaine's DeepCwind

Offshore options

Heather Martin, center, a UMaine graduate research assistant in civil and structural engineering, assisted in the development and testing of the scale-model turbine.

Consortium to develop floating offshore wind turbines. Complex equations predict the effects of interacting forces like wind, waves and gravity on floating wind platforms, and represent the best knowledge available in the field. However, they remain incomplete until more comprehensive testing is finished.

The offshore wind research program began in 2008 with discussions between AEWC Director Habib Dagher, Assistant Director Robert Lindyberg and Maine Maritime Academy Associate Professor of Engineering Richard Kimball, who set out to enter the offshore wind industry and prove the models created by NREL. They obtained their first grant of $600,000 from the National Science Foundation in 2009.

"We saw an opportunity to jump-start the program here in Maine, specifically at the University of Maine, to provide useful data for the industry and, in the process, become experts in the design of offshore wind turbines," says Kimball.

This vision has developed into a multiphase, 20-year Maine Offshore Wind Plan, led by the approximately 35-member DeepCwind Consortium, which includes academic institutions, nonprofits, government agencies, utilities and manufacturers. The program has garnered $1 million in funding from the Maine Technology Initiative, another $7.1 million from the Department of Energy and $6 million in state bond funds for an offshore wind test site off Monhegan Island.

The offshore wind program's growth can also be marked by the number of young professionals, graduate researchers and undergraduate students who are involved in the project.

Assistant Research Professor in Mechanical Engineering Andrew Goupee received his undergraduate, master's and doctoral degrees in the discipline from UMaine. In that time, he conducted research in "everything from composites to rocks" and now uses his dynamics and numerical modeling experience to refine NREL's models.

Goupee is enthusiastic about providing other students with the research opportunities he has found at UMaine, noting that the program has received internship applications from students at UMaine and other universities.

"I hope to involve more graduate students and transition to a role where I'm working with them on the research end of things," Goupee says. "We have a few good students in the pipeline and more are coming."

A growing offshore wind industry would provide Maine college graduates with opportunities to stay in the state and build a career, Goupee says.

"When I got my undergraduate degree in 2003, there were all kinds of job opportunities. They couldn't (hire) engineering graduates from UMaine fast enough," Goupee says. "There's a great sense of pride in working on this type of project."

UMaine and AEWC have the potential to serve as a resource and stepping-stone for bringing renewable energy technology to Maine. According to Goupee, the center's greatest strength is its history of developing technology and intellectual property that can benefit Maine companies and generate revenue.

"We've shown a track record of being able to create or advance products that are viable in the marketplace and create jobs. There is a lot of work to be done in the renewable energy sector, but there's so much potential in my opinion," he says. "That is the best angle this center can take — to create more jobs in the state."

Heather Martin, a graduate research assistant in civil and structural engineering, played a lead role in the manufacture and assembly of the scale-model wind turbine used to test the platforms, and hopes to work for one of the many Maine companies that will form the state's offshore wind supply chain.

"I would love to stay in Maine and continue to work toward making this a reality," Martin says. "I see myself in more of a people-to-people managerial role, though it will take some work to get there."

Martin had the opportunity to supervise and manage multiple undergraduate and graduate assistants as they constructed 4-foot carbon fiber blades that weigh less than a third of a pound, a process that she calls "a great but tough learning experience."

"My role has been the research, fabrication and design of a scale-model wind turbine.

In the Netherlands, Andy Goupee, second from the left, a UMaine assistant research professor in mechanical engineering, collected data for dynamics and numerical modeling to refine the Department of Energy's National Renewable Energy Laboratory models.

I've been acting as kind of a project manager and by default I've become the go-between between UMaine and MMA."

The long hours and hands-on experience helped Martin write her graduate thesis focused on ocean engineering, and propeller and turbine design. Working with other laboratories and subcontractors has opened her eyes to the many opportunities she can pursue after graduating this year.

"I think of this not just as my graduate school experience, but the beginning of my professional track," Martin says. "I am very grateful for it because I'm getting great exposure to interesting people and I'm able to heighten my own skills, not just as a student and a learner, but as a doer."

Martin's team faced the daunting challenge of constructing a wind turbine with "robust and durable instrumentation" that weighed less than 10 pounds. As a result, she learned attention to detail and is familiar with every piece of the machine.

"Every bolt on the turbine has been specially engineered and every sensor has been sized with at least two or three people doing the research," Martin says. "Everything on this turbine is top-notch."

A single turbine is a great accomplishment, but Martin and

The 1:50-scale turbine blades were manufactured using a lightweight carbon fiber. Each blade weighed less than a pound.

her colleagues needed to go a step further and build a second one simultaneously. The precaution was tedious, she says, but necessary because the offshore wind team was creating original technology and couldn't be sure how it would perform at MARIN.

"They have a wealth of experience in the model testing world and Habib (Dagher) is trying to bring that back so we can do that sort of thing here rather than outsourcing outside of the country," she says.

Goupee agreed that partnering with MARIN provided new opportunities and capabilities for the model testing program.

"It truly is a groundbreaking test. We have enlisted the help of one of the best— if not the best wave basin facility in the world," he says.

The 1:50-scale testing followed an aggressive timetable, but Goupee was confident it would be a success. He says that even if the team had gathered 95 percent of the data, it will be "infinitely more than anyone has ever produced before."

"All of our partners who have helped us greatly have put a lot of effort into this. We're proud of what we've done so far and if it works out, you'll see a lot of smiles," Goupee says. "It will be something for the center to hang its hat on."

Kimball, who consulted as a technical lead for the model testing program, says this experiment is one of the most challenging and rewarding he has worked on in his career.

"The combination of two very different industries — the offshore industry and the wind turbine industry — focused on new technology, has been very exciting for me, for the students and also for the future of Maine," he says.

Goupee is excited to see these industries come together to improve Maine's economy and says the offshore wind project is equipping AEWC to lead the way.

"We've learned a lot. When we started this project, we didn't have a clue where to begin," he says. "We're looking to be the experts so when people are interested in this area in the future, we can be the place for them to start."

A piece of this vision is the Offshore Wind Laboratory, a 37,000-square-foot addition to AEWC that was completed in August. The expansion enables the design, prototyping and testing of composite or nano-composite structures for the deepwater offshore wind industry.

"We will have the knowledge, the skill and, of course, the facility for structural testing and developing manufacturing aspects," Goupee says.

For students and young researchers at the university, these achievements and developments represent a brighter future.

"I feel like I'm at the forefront of something that could really change Maine — and, potentially, the United States — for the better. I'm extremely lucky," Martin says. "The timing was really right in terms of my education and what I could bring to the project." ■

Environmental health

Lynda Fredette
B.S. in civil engineering, UMaine, 1984
M.S. in management, with a concentration in environmental management and policy, Rensselaer, 2000

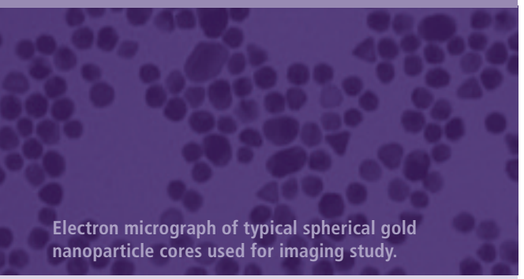
Manager, Global Environment Health & Safety Compliance Assurance, United Technologies Corp., Pratt & Whitney, Hartford, Conn.

Pratt & Whitney, a United Technologies Corp., company, is a world leader in the design, manufacture and service of aircraft engines, industrial gas turbines and space propulsion systems. Pratt & Whitney reported an operating profit of $1.99 billion in 2010 on revenues of $12.94 billion. The company's 36,000 employees support more than 11,000 customers in 195 countries around the world.

Milestones in your career after graduating from UMaine?
I was a research chemist/engineer with the U.S. Army Cold Regions Research and Engineering Lab, part of the Army Corps of Engineers' Engineer Research and Development Center, Hanover, N.H. (environmental contamination assessment/cleanup-related projects) from 1985 to 1986, then worked as a civil/environmental engineer with the consulting firm of Loureiro Engineering Associates, Avon, Conn. In 1988, I joined Pratt & Whitney as an environmental engineer, then worked as an environmental, health and safety (EHS) management systems specialist; the facilities and services health and safety coordinator; EHS manager for Pratt & Whitney's largest factory site in East Hartford; EHS information technology manager; Green Engine Program manager; and, since 2004, as global EHS manager.

From your perspective, what's the next big thing in engineering?
Civil and environmental engineers will have greater opportunities to get involved in research and design of more energy-efficient structures and products as the world places greater emphasis on reduced carbon footprints. LEED-certified buildings are one example.

How did UMaine prepare you for this career?
Environmental engineering and chemistry courses prepared me to understand U.S. environmental regulatory requirements, pollution sources and treatment system design principles. Engineering economics and project management helped me manage projects efficiently and cost effectively. Mechanical engineering gave me a basic understanding of materials and combustion engine design principles, and some of my humanities courses like Chinese history came in handy when I had a couple opportunities to travel to Asia. ■



Electron micrograph of typical spherical gold nanoparticle cores used for imaging study.

Improving the prognosis

Nanoparticles offer new hope in the fight against cancer

In the ongoing effort for early detection and treatment of cancer, nanoparticles are helping shine new light — and offer new hope — in biomedicine. At the University of Maine, that biomedical research is led by Michael Mason and his team of graduate and undergraduate researchers who are focusing on the photophysics of nanoparticles and molecular nanoprobes.

Mason, an associate professor of chemical and biological engineering, collaborates extensively with Dr. Peter Allen of the Memorial Sloan-Kettering Cancer Center in New York City, who specializes in treating pancreatic cancer. Together, they have developed a minimally invasive diagnostic procedure that tests tissue for cancer cells while the patient is still on the operating table.

Gold nanoparticles are used to tag cancer cells, allowing surgeons to identify cancerous tissue more quickly and efficiently. The metallic nanoparticles are guided by attached biomolecules that are attracted to specific molecules on the surface of cancer cells.

The technique is sensitive enough to reveal even a single cancer cell.

The researchers also have found noninvasive methods that make use of nanoparticles as image contrast agents for X-ray CT imaging. While traditional iodine-based agents are easily flushed out of the human body, gold nanoparticle-based contrasting agents can remain circulating in the bloodstream for many hours, allowing for dramatically improved imaging and earlier detection of cancer.

The nanoparticles used in these methods are grown in the lab as miniature crystals, and their potential application depends on the material used, size, shape and surface chemistry. New nanoparticles are designed based on photophysical laws or chemical principles, which dictate how the nanocrystals will interact with specific kinds of light or behave in a certain biological environment.

For example, Mason says, spherical silver nanoparticles with diameters on the order of 15 nanometers efficiently scatter blue when a white light is shined on them, while gold nanoparticles of the same size reflect red or green. That way, oncologists know what color to look for when they get under the microscope. For X-ray contrast, different selection criteria is used to determine the optical size or material used.

To ensure the gold nanoparticles find and latch on to cancer cells, Mason engineers them specifically to bond with a cancer antibody. The antibody searches out cancer cells in the body, and the bonded nanoparticle then becomes visible when illuminated with light.

The challenge arises when the nanoparticles meet the human body. While noble metals such as gold and silver are inert at the macroscale, say for use as jewelry, they may be very reactive and even toxic at the nanoscale. For example, silver and platinum are toxic in minute amounts because they have extremely high surface energy. To avoid these complications, Mason coats the surface of the metal nanoparticles with a biologically inert polymer containing sulfur atoms. These sulfur atoms form a nearly unbreakable bond with gold, protecting the patient from the adverse effects of the metal surface, and the metal surface from the aggressive biological environment.

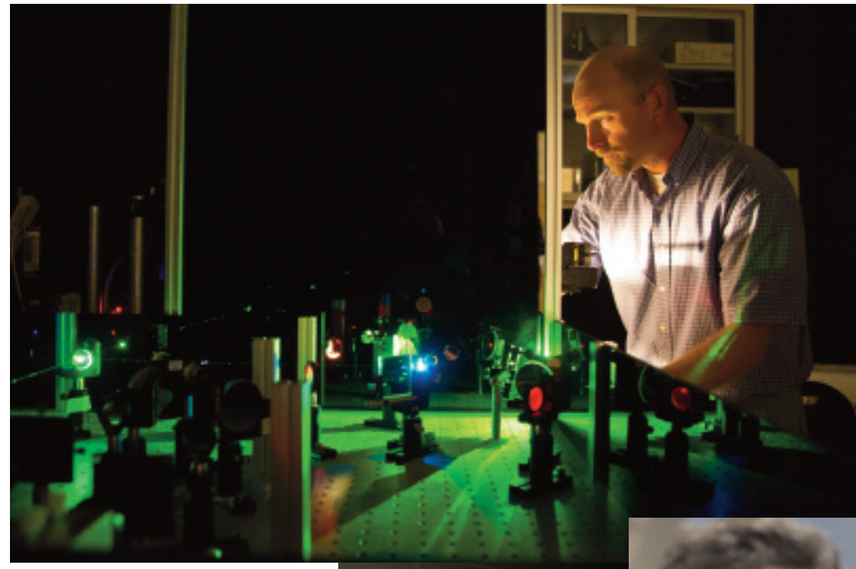
In the past five years, Mason's team has received more than $600,000 to investigate biological and medical applications of nanoparticles. Funding sources have included the Maine Cancer Foundation, the Memorial Sloan-Kettering Cancer Center and the Defense Department.

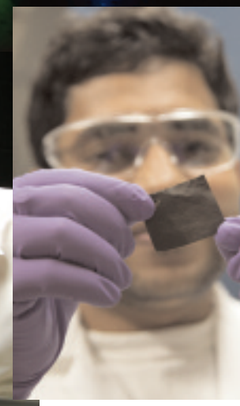
Mason's team also has developed its own devices to aid in the discovery and characterization of new nanomaterials, some of which he hopes to commercialize. He is particularly interested in collaborating with surgeons on the front lines — the doctors who he says are thinking, "We need to do better at this."

"At first, scientists can't ask the right questions, and doctors don't know what the scientists are capable of," he says. "They have to spend enough time together to establish a dialog."

After talking to surgeons, especially pancreatic cancer surgeons, the ability to improve the prognosis and the potential to help patients is motivating, Mason says.

"Seeing something go from the lab bench to being in use is awesome," he says. "What we have is very exciting, and we're definitely looking into intellectual property." ■





Biomedical researcher Michael Mason, pictured above, focuses his research on photophysics of nanoparticles and molecular nanoprobes, single-molecule imaging and time-resolved single photon spectroscopic imaging techniques. Among the chemical engineering Ph.D. students in his lab are Anna Sitarski and Sanjeev Kandpal, pictured far right.

Bruce Segee is the technical director of UMaine's supercomputer projects. Supercomputer collaborators include the University of Southern Maine, NorthEast Research and Education Network, and Northeast Cyberinfrastructure Consortium (NECC). NECC has opened collaborative data sharing with researchers in Maine, New Hampshire, Vermont, Rhode Island and Delaware — five states considered lacking in regional cyberinfrastructure.

supersized BENEFITS

Maine businesses and schools plugging into UMaine's supercomputing capabilities

High-performance computing that began in 2000 with the University of Maine's first supercomputer and an assignment to help the military refine guided missile aerodynamics is now becoming available for Maine businesses, students, libraries and state government.

UMaine's advancing supercomputing capabilities — coupled with ongoing upgrades and a federally funded expansion of high-speed Internet infrastructure for thousands of Maine households, businesses and laboratories — are creating new information superhighways and opportunities for a growing community of users with high-performance computing needs.

"Supercomputing is critical for industries in Maine, as well as many R&D efforts," says Dana Humphrey, dean of UMaine's College of Engineering. "It's used by many companies, such as Jackson Lab, Central Maine Power and Applied Thermal Sciences for their high-capacity computing needs, allowing them to move their businesses forward."

Maine businesses, for example, can determine the best hull shape to reduce drag, model the best artificial heart valve design, quickly render multiple architectural drawings and concepts, predict how new regulatory policies will affect fisheries, and study growth scenarios and market planning. Students can better understand how shifting atmospheric conditions affect climate change by suggesting various condition changes. Scientists and researchers, meanwhile, can widen collaborative networks and use the university's supercomputing capabilities to advance research with the new high-speed data transmission system.

"The state's infrastructure is growing by leaps and bounds," says Bruce Segee, the Butler Professor of Electrical and Computer Engineering, and technical director of UMaine's supercomputer projects. "Supercomputing isn't a bunch of techno geeks and science wonks who are advancing the state of the art in computing. It's scientists and climate modeling, and people looking at business growth and the status of marine science. It's not the technology, but what it's capable of doing."

The university's supercomputer at Target Technology Center in Orono has 100 terabytes of memory and a bank of more than 500 computer processing units. And now with funding from the Maine Technology Asset Fund, a second supercomputer, to be housed in Neville Hall on campus, will be available in early 2012 to multiple users in co-op fashion, much like a utility — a more efficient, economical model than if all the users invested in smaller systems.

It's important to Segee that user costs be kept affordable so the supercomputer remains accessible to the expanding and varied groups of new users.

"We want to have the nurses and the biologists and the social workers on the supercomputer," he says, in addition to those with limited budgets, such as state government, libraries or nonprofits. "I think as a state, we benefit more from the outcomes this resource delivers than from any fees it could generate."

Similarly, enabling Maine students to access the supercomputer from their desks "literally opens them up to the world, and the number of things that it allows is just phenomenal," Segee says.

Driving the most recent system enhancements are the public and private partnerships forming complex symbiotic relationships with varied funding resources. That's allowed multipronged progress — from sophisticated scientific research to public interests, according to Segee and Phil Lindley, executive director of the ConnectME Authority, which coordinates high-speed broadband expansions in rural Maine.

Segee describes the relationships and upgrades as a jigsaw puzzle. "Any piece by itself isn't particularly useful," he says. "You have to have all the pieces put together the right way."

Through major funding from the National Science Foundation's EPSCoR (Experimental Program to Stimulate Competitive Research) and the National Institutes of Health, the Maine Technology Foundation and the University of Maine System's CIDER (Cyberinfrastructure Investment for Development, Economic Growth and Research), participants have coalesced in purpose over the last decade.

At least 14 higher education institutions, with more than 250 faculty and students directly engaged in research, now have UMaine supercomputer access, according to Vicki Nemeth, director of Maine EPSCoR.

"The ability to effectively communicate, collaborate and do synergistic research across campuses is key to the success of these programs," says Nemeth. "Maine EPSCoR has been a key supporter of cyberinfrastructure improvements in the state, including increased access to high-speed bandwidth through the expanding fiber-optics system — which gives our researchers access to the national backbone — new videoconferencing and visualization capabilities, and the use of UMaine's supercomputer for data sharing, analysis and cloud computing."

In addition, the upgrades are augmented by $25 million in 2009 federal stimulus money from the Department of Commerce for the Three Ring Binder Project that strings 1,100 miles of new fiber-optic broadband cable in three redundant loops in northern, eastern, central and southern Maine.

"I would say that UMaine is leading the way in Maine," says Jeffrey Letourneau, executive director of Networkmaine for the University of Maine System who helped coordinate the Three Ring Binder Project.

"I don't know that there is anybody else in Maine to drive forward the investments in infrastructure to improve economic development," Letourneau says. "This supercomputer is a big part of that. It's the next layer of what's been happening in the state." ■

At the Laboratory for Surface Science and Technology, George Bernhardt is involved in cutting-edge research in numerous projects, and operates and maintains the equipment in the Thin Film Synthesis and Processing Facility, and the Micro/Nano Device Fabrication Clean Room Facility. That research experience comes into the classroom to show students in Physics 121 and 122 courses the real-world applications of what they're learning. "Research keeps you fresh and helps you keep up with the science, which I can bring into the classroom," says Bernhardt. "Teaching helps you keep up with the students. You can't teach in isolation."

serious PHYSICS

George Bernhardt's blend of offbeat humor, science and engineering results in memorable lessons

As George Bernhardt will tell you, every science professor at some point in his or her education has had "that teacher" — the one who seems capable only of facing the blackboard and solving problems in a monotone.

Bernhardt has a different strategy. Self-described as "loud and slightly obnoxious," he likes to make side comments and jokes throughout his lectures for PHY 121 and 122, a pair of required, introductory, calculus-based physics courses at the University of Maine for engineering and physical science majors. As a result, his classes are memorable — and legendary.

For example, Bernhardt was deriving equations on the board in class one day when a student spilled a bottle of iced tea. Bernhardt's response: "Now we see the dangers of drinking and deriving."

"Is my humor any good? Nah, it's horrible," says Bernhardt, a research scientist with UMaine's Laboratory for Surface Science and Technology (LASST) and the recipient of the 2010 Leila C. Lowell Award in the College of Engineering. "But what it does is it gets them engaged."

Bernhardt has a real talent for exciting people about science, engineering and technology, whether through the physics courses he's been coordinating for 20 years, the students he mentors as a LASST researcher or the educational outreach he does to promote understanding of engineering.

For him, success is re-creating the moment years ago when engineering and science clicked for him. Today, seeing students understand is an enormous satisfaction. In the rigorous physics courses, disarming humor helps the UMaine students connect with the concepts. They also discover a passion — comparable to Bernhardt's — for engineering and science.

"He does tell a lot of jokes," says Finn Bondeson, a first-year civil and environmental engineering major in the class. "Not only do they lighten the mood of the class and make it a comfortable learning atmosphere, most of them are based on physics terms. This helps students remember what a term means or how to use the concept."

Bernhardt really knows how to get students involved, whether he is making jokes, showing the class experiments or relating the material to real life, says Audrey Knowlton, a first-year marine biology major. "He has a positive and enthusiastic energy that constantly grabs your attention," she says.

The classes, often with enrollments of more than 200, involve Bernhardt's painstaking coordination, including the training of teaching assistants to carry out the courses' related laboratories and recitations — sessions in which students go over their homework with either Bernhardt or a TA. It is a monumental orchestration effort considered essential to the teaching mission of the College of Engineering.

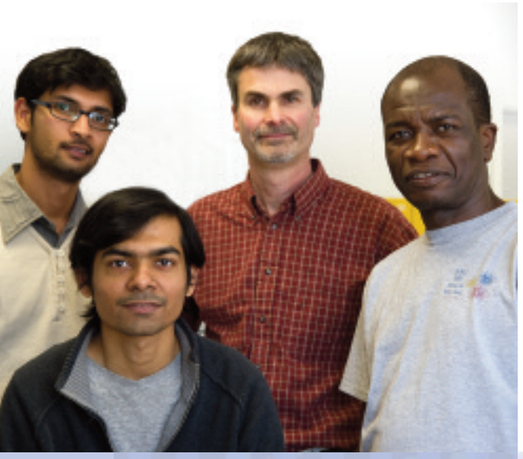
"Finding time to go get help can be challenging for a lot of students in big classes," says Kara Zadakis, a first-year civil engineering major. "Recitations help this because it's a set period in your schedule where you can go to get more information about a topic discussed in class, along with talk to the TA if you need help on a homework problem."

PHY 121 and 122 are critical courses not just to engineering majors but students from different science majors — biology, physics, chemistry, marine science, biochemistry, zoology, pre-med, Earth science and wood science. The goal is to "give them these basics so that when they go back into their major and the physics comes back to haunt them, they'll think, 'I know how to do this,'" Bernhardt says. "It's critical that they can think critically, that they can solve problems. And that means that they have to be paying attention."

To lay that foundation, Bernhardt collaborates with David Clark in the Physics Department and with John Thompson and Michael Wittman in UMaine's Physics Education Research Laboratory to bring content to the classroom in a way that is most helpful to students. Bernhardt compares learning science to using a cookbook: You can follow the recipe and it will come out pretty well, he says, but "true genius is modifying that recipe, saying, 'Well, this would be better if I added this or took this out.'"

The key is in equipping students with the skills — a toolbox — to tackle any problem.

In that way, he says, students should know theoretically how to solve a certain type of problem before they ever encounter it. ■



Current members of UMaine's Paper Surface Science research team are, left to right, graduate students Pavan Sindhe and Muddasir Khan, professor Doug Bousfield and graduate student Finley Richmond. UMaine's Paper Surface Science Program is one of only a handful of such programs in the world and is an international leader in the investigation of paper and coating surfaces on a micro/nano scale and the application of leading-edge instrumentation to these areas of investigation.

Paper trail

UMaine's surface science research benefits paper companies and the industry

Take a look at the paper this magazine is printed on. Run your hand over the surface. Hold it up to the light and notice the sheen. By bringing the pages really close to your eyes, you might even see where the ink from each letter ends and the paper begins.

There's a lot more to paper than casual readers notice. For starters, some of what you read — this magazine, for instance — is printed on coated stock, that is, paper covered with a thin layer of pigments held together with latex or other binders. The coating makes the paper smoother, heavier, stronger and brighter.

The interplay of coating, ink and paper is pivotal to printers, designers and the paper industry. Given that Maine is a leader in coated paper production, anything that makes that interplay better or more efficient is good for the economy.

That's where UMaine's Paper Surface Science Program comes in. Since 1993, this consortium of graduate students, faculty researchers and industry professionals has worked to improve the process and the product. The program complements UMaine's Pilot Plant, which works with companies to find quick, often confidential solutions to specific problems.

"We're trying to do long-term projects that are beneficial to the industry," says the program's director Doug Bousfield, a UMaine professor of chemical and biological engineering. "For example, maybe one company is having trouble with a coating that is too rapid in setting. It would go to UMaine's Pilot Plant to try various things to solve the problem quickly, without a deep understanding of what needs to change. What we do should be helpful for them in the future — help find a better understanding of why that happened and how they can avoid it."

It's a rare model, one in which participating corporations make a donation — enough to fund a graduate student for one year — so that the entire industry can benefit from the body of research.

Some of the partnering companies end up hiring the students they've put through the program, while others just like the idea of furthering the industry as a whole.

"We're trying to find very practical, real-life problems and issues in the paper and printing industry that also can make good theses for graduate students," Bousfield says.

A representative from one of those companies, Sappi Fine Paper North America, says membership on the consortium's board has provided an opportunity to recommend research projects that are mutually beneficial, including coating-ink interactions, development of micro- and nanoscale testing of paper surfaces for uniformity, and investigations into layer strength in multilayer paper structures.

"We have also been able to hear about this work many months in advance of formal publication and have the unique opportunity to discuss the implications of the results with the work's authors directly," says Al Osgood, associate research fellow at Sappi Fine Paper's Technology Center.

According to Osgood, the program regularly attracts visiting scientists, doctoral candidates and postdoctoral researchers from worldwide coated paper manufacturing areas — Japan, China and Europe — to study paper structures, surfaces and the colloidal interactions of the materials used in and on them. The consortium is often invited to present at such events as TAPPI's peer-reviewed Coating Conference. In addition, many technical journals worldwide publish the group's research.

By examining coating, sizing and printing practices, the research group has been able to make key contributions to the industry, including a better understanding of the rate of ink setting on paper — similar to the way glue sets or dries. Bousfield's team has also examined how latex binders work and how they impact the strength of the coating layer. If a coating isn't strong enough, it will pull off the paper during the printing process. But paper makers are always looking for ways to use less latex — in part because of cost concerns, and in part because latex is petroleum-based.

A Ph.D. candidate in the program, Finley Richmond, is trying to find a way to make coatings that contain nanocellulose, produced from wood fibers, to increase the effectiveness of latex. One master's student, Pavan Shinde, is working to understand what properties of latex are most important to improve its binding behavior.

"If a paper company can adjust its coating formulation a small amount, it could save a large amount of money," Bousfield says. "Small things translate to big savings." ■

Improving heart valve surgery

Biomedical engineering research focused on giving patients minimally invasive treatment options

In recent decades, biomedical technology has revolutionized human surgical procedures, leading to effective and less invasive treatments for a myriad of health conditions. Those include matters of the heart. Today, coronary artery disease and other cardiac conditions often are treated with percutaneous procedures, such as angioplasty or stents, requiring small incisions rather than full, open heart surgery.

But some heart conditions have defied such surgical advances. Among them is one of the most common heart valve conditions — mitral regurgitation, in which the valve between the left atrium and ventricle does not close properly. In patients with life-threatening dysfunction, open heart surgery is done to repair or replace the valve.

To advance percutaneous mitral valve repair, computational models are needed to help surgeons and biomedical engineers understand what's needed and what's possible for less-invasive treatment alternatives. One of the leaders in that modeling research is Karyn Kunzelman, a research professor in the University of Maine's Department of Mechanical Engineering. Kunzelman has developed and incorporated microstructural analysis techniques into her modeling studies of cardiac valve tissue.

For more than two decades, she has collaborated on medical and surgical research with Dr. Richard Cochran, a member of UMaine's mechanical engineering graduate faculty and director of cardiovascular and thoracic surgery at Maui Memorial Medical Center. Kunzelman and Cochran are internationally recognized for their use of computer modeling and engineering analysis of the heart and heart valves, cardiac devices and surgical procedures. They also are developing surgical repair techniques.

In 2006, they founded Superior Surgical Solutions, which focuses on research management, program development, and product development and evaluation. The business started in Auburn, Maine, when Cochran was medical director of cardiac surgery and Kunzelman was director of research at the Central Maine Heart and Vascular Institute at Central Maine Medical Center. Kunzelman is president of Superior Surgical Solutions.

Kunzelman and Cochran created the first 3-D structural finite element computer model of the mitral valve to aid in structural analysis of normal function, pathological alterations and surgical correction. They also developed the first fluid-structure interaction (FSI) model to analyze mechanical and fluid flow disturbances resulting from pathologic conditions and proposed repairs.

In 2009, Kunzelman received a five-year, $3.1 million National Institutes of Health grant to validate the fluid-structure interaction model of percutaneous mitral valve repair — the largest NIH grant ever to UMaine. With validation, the fluid-structure interaction model could aid clinical assessment and surgical planning not just for mitral valve conditions, but also for many diseases and repairs done surgically or with percutaneous techniques.

Kunzelman is collaborating with Cochran and professor Bruce Segee, the technical director of the UMaine supercomputer, as well as researchers at Georgia Institute of Technology and the Department of Energy's Pacific Northwest National Laboratory. They are comparing computational FSI results to data from in vitro experiments done at Georgia Tech's Left Heart Simulator. The experiments will simulate normal function, two pathological mitral valve conditions, and the procedure known as edge-to-edge repair.

In the coming year, two UMaine postdoctoral research associates will work with scientists at Pacific Northwest National Laboratories, where the focus is on developing a series of next-generation procedures and fluid-structure interaction models of the mitral valve. The results will aid surgeons and cardiologists in providing the best possible interventional options for patients with mitral valve disease, Kunzelman says. ■

BY THE NUMBERS

Engineering is vital to growing Maine's economy.
From 2007–11, the College of Engineering powered economic development with:

21 U.S. Patents Issued

94 Invention Disclosures Submitted

5 Spin-off companies

$11.9 million in Contracts & Grants WITH INDUSTRY

TOTAL RESEARCH EXPENDITURES
$118,799,000

13 *Licensed Technologies*

$68,737,000 FEDERALLY FUNDED EXPENDITURES

69 U.S. Patents Submitted

Sources: University of Maine Department of Industrial Cooperation and Office of Research and Sponsored Programs

Managing technology quality

Steve Swan
B.S. in electrical engineering, UMaine, 1982
M.B.A., University of Phoenix

Site Engineering Manager for Quality at National Semiconductor, South Portland, Maine.

National Semiconductor's plant in South Portland specializes in complex analog computers. The products cover thousands of applications across markets, such as smart phones, wireless communication, LED lighting and industrial applications. Each month, more than 100 million chips comprising 20 different technologies are shipped from its plant. Products made in Maine are shipped to Malaysia for assembly, and then sold to customers such as Apple, Cisco, Ford, Motorola, Nokia and Seagate.

Earlier this year, National Semiconductor and Texas Instruments entered into an agreement whereby TI would acquire its smaller rival, pending regulatory approval. Swan says that development opens even more doors for him and other National engineers to take their careers to the next level.

Milestones in your career after graduating from UMaine?
I started as an equipment engineer at Fairchild Semiconductor in South Portland, then went into process engineering before moving to Digital Equipment Corp. (now an Intel plant) in Massachusetts. In 1993, I joined National Semiconductor in South Portland as an engineering manager on the team that started this facility. This is classified as a 200 mm fab, which, at the time, was cutting edge — the coolest technology around. This chip factory represented the next generation of growth for National. Again, I was fortunate to be at the center of the latest technology. My current responsibility is to ensure that every chip we produce meets customers' expectations for quality and performance. We strive for a theoretical benchmark of zero defects, so that means the pressure's always on.

From your perspective, what's the next big thing in engineering?
Some new trends that we are seeing are high-voltage chargers for electric cars, current drivers for LED light bulbs and high-speed chips for wireless technologies. It's impossible to say for sure what will be the next killer technology, but it could very well be something no one's thought of yet.

How does UMaine continue to influence your life?
I'm on the College of Engineering board of advisers. In the Department of Electrical and Computer Engineering, National Semiconductor is involved in an active co-op program and a microelectronic scholarship program. A third of our engineers graduated from UMaine and we have a strong interest in the program continuing to thrive. ■

Recovering energy

When Tavis Wallace first heard about the potential of thermoelectric power generation — which relates to the production of electric power from waste heat — the then-Maine Maritime Academy undergraduate from Crawford, Maine, could easily picture the technology's possibilities for the maritime industry. A marine vessel running on the energy created by its own exhaust heat? The potential for millions of dollars in energy savings? How could Wallace not be interested?

Now a graduate student at the University of Maine, Wallace is combining his pursuit of a master's degree in mechanical engineering with his own start-up business centered on the thermoelectric technology.

While at Maine Maritime, Wallace worked with other undergraduate students and faculty to build one of the first thermoelectric-powered hybrid marine vessels in the world. He founded his company, Thermoelectric Power Systems LLC, with the goal of developing and marketing the technology to the marine industry.

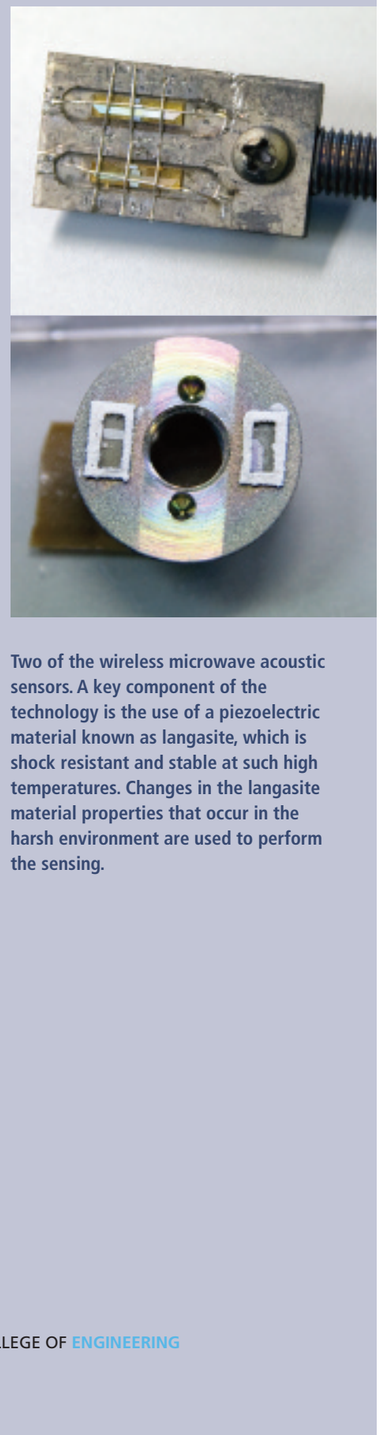
"We took an encapsulated lifeboat and retrofitted it with a new diesel electric propulsion system so we could utilize the energy harvested from the generator and put it back into the system," says Wallace, who is an advisee of UMaine assistant professor Zhihe Jin and Paul Wlodkowski, a Maine Maritime engineering professor who holds a UMaine graduate faculty appointment. "Basically what it's doing is reducing the load on the generator and therefore reducing the fuel consumption."

UMaine electrical and computer engineering associate professor Bruce Segee is involved in the project's instrumentation and automation. Maine Maritime's Peter Sarnacki, an associate professor of engineering at Maine Maritime with technical experience in the type of propulsion system Wallace is using, is also involved.

Wallace has set an aggressive goal of working toward a 5 percent decrease in fuel consumption for the entire fleet in Maine, from lobster boats to luxury yachts. That 5 percent reduction translates into millions of dollars per year.

Thermoelectric Power Systems has received more than $175,000 in grants for research and development from organizations such as the American Bureau of Shipping and the Office of Naval Research. This winter, it received a small but prestigious grant from the Portland, Maine-based Libra Foundation. The grant was enough to update the thermoelectric generator's data acquisition systems. ■

Travis Wallace's retrofitted vessel looks more like a submarine than a boat. The technology involves installing a thermoelectric generator in the exhaust path of a vessel's internal combustion system, enabling the recovery of energy that is otherwise lost through heat in the exhaust gases.



Two of the wireless microwave acoustic sensors. A key component of the technology is the use of a piezoelectric material known as langasite, which is shock resistant and stable at such high temperatures. Changes in the langasite material properties that occur in the harsh environment are used to perform the sensing.

New sensors could improve performance

Jet *efficiency*

After nearly a decade in research, development and testing, engineers in the University of Maine's Laboratory for Surface Science and Technology (LASST) have created wireless high-temperature sensors able to stand up to at least 1,800 degrees Fahrenheit — more than twice the heat endurance of existing wireless sensors.

The sensors are expected to save the aerospace industry and military billions of dollars in costs associated with jet engine maintenance.

Prototypes are now being tested in a jet turbine engine on indefinite loan to UMaine from the Maine Air National Guard.

The wireless, harsh-environment sensors were developed by Mauricio Pereira da Cunha, professor of electrical and computer engineering, and Bob Lad, professor of physics and director of LASST. Funding has come from the U.S. Air Force and Army, and university and state grants.

The sensors can be attached to jet engine blades and other moving parts operating with a g-force acceleration in excess of 50,000 and temperatures in excess of 1,800 F. With them, technicians can monitor such variables as pressure, temperature, strain, vibration and corrosion, and better control engine health and maintenance.

Because such sensors have not been available, jet engine mechanics routinely and laboriously dismantle engine parts according to maintenance schedules to look for evidence of wear or damage. In addition, the sensors will improve engine efficiency, saving fuel costs.

Demonstration of the performance of wireless sensors in jet engines is being watched by a number of groups, da Cunha says. Partnering organizations range from private sector companies including Pratt & Whitney, Rolls Royce, Honeywell and General Electric to NASA and several miliary branches.

UMaine has two patents and three pending on the microwave acoustic sensor devices, high-temperature materials and wireless communication. In addition, the university has received more than $3.6 million from the Wright-Patterson Air Force Research Laboratory in Dayton, Ohio, to help develop the technology for commercialization and deployment in military aircraft.

The UMaine technology is being licensed to Environetix Technologies Corp., a new spin-off company from LASST and located in Orono's Target Technology Incubator, where it employs several recent UMaine graduates. ■

The REU difference

Why electrical engineering?
I've always loved to build things. I'm also a strong math and science student so engineering was suggested to me as a major. I picked electrical partially because my dad is an electrical engineer and because of scholarship money I got from the department freshman year, but I'm really glad I picked it. Electrical engineers have a ton of job opportunities with all of the upcoming technology, plus it's really fun to design a circuit and get it to work.

Tell us about your REU last summer.
Last summer I worked for electrical engineering professor Rosemary Smith on microfabrication of pressure sensors that will hopefully be used to wirelessly detect eye pressure to diagnose glaucoma. The project is still in its early stages, but I had the opportunity to design and fabricate the sensors in the Laboratory for Surface Science and Technology (LASST) clean room and do some testing at the end of the summer. REU (the National Science Foundation's Research Experience for Undergraduates) is a really cool program because you get to work on a specific project with a professor all summer and learn what research is all about. I have submitted some CAD designs of sensors to a company that will fabricate them. The designs are similar to the sensors I worked on during REU. I hope to get the chips back for testing.

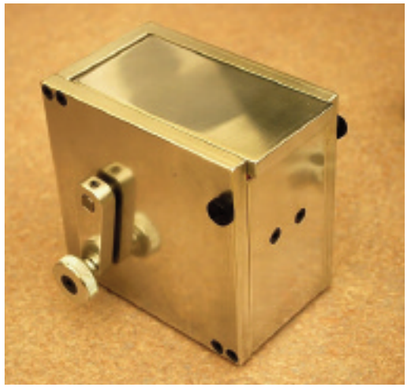
Have you participated in any other internships or co-ops?
The summer after my first year, I interned at Fairchild Semiconductor in South Portland for the Device Engineering Department. I've also worked at Network Allies in Andover, Mass.

Who's your mentor?
I've worked closely with quite a few professors; however, Dr. Rosemary Smith is an amazing mentor to me. She is the only woman professor in the ECE Department and is an inspiration to all women who are pursuing degrees in male-dominant fields. I've spent a lot of time in her office talking about everything from current projects and homework to what it's like at a job interview or how to fit in.

What research do you hope to be involved in as an electrical engineering graduate student?
I'm hoping to continue working on the pressure sensors that I worked on during REU. I'd like to try to get the wireless portion of the design working. After graduate school, I plan to apply for jobs in the semiconductor industry. I hope to work in chip design and eventually move up to a management position. ■

Jamie Reinhold
South Portland, Maine
May graduate and incoming grad student in electrical engineering

Member of the UMaine chapter of IEEE, Eta Kappa Nu, Tau Beta Pi and Kappa Kappa Psi; Black Bear Marching Band, Pep Band and Concert Band (playing clarinet and tenor sax); and the championship-winning Hippie Flicks intramural frisbee team.



This year's top design for a pill crusher (pictured above) was created by the team of Thomas Evans, Justin Hagelin, Paul McClay, Brad McLeod and Kevin Scott. When the MET teams work on their designs, they have to create user-friendly blueprints that could be followed by someone not involved in the project. The students research prior designs and patents, as well as what is currently on the market, before coming up with their goals. They also brainstorm many different solutions to the selected problem, then develop plans, some of which they even document with video demonstrations. In addition, teams need to perform calculations to gauge strength and safety. With the pill crusher project, the groups needed to prove mathematically that their products could be used by the average person and that they wouldn't pinch anyone's fingers in the process. These calculations are kept in a log book that also contains notes and photos the teams compile over the year through class assignments.

ingenuity Engineering

For three decades, two MET capstone courses have set the bar high on addressing humanitarian needs

In his 2011 State of the Union address, President Barack Obama called for innovation in today's global marketplace. He pointed out how such countries as China and India have adapted to compete in the world. And he assured the nation that the U.S. has what it takes to contend as well.

"We know what it takes to compete for the jobs and industries of our time," Obama said. "We need to out-innovate, out-educate and outbuild the rest of the world."

And as Herb Crosby tuned in at his home in Orono, Maine, that line caught his attention.

"He described our students to a T," says Crosby, who teaches mechanical engineering technology at the University of Maine.

Particularly the students of MET 464 and 465, a pair of courses in which mechanical engineering technology seniors complete a yearlong design project that serves as their capstone requirement for graduation. Crosby has taught the courses since 1980 and in those 31 years has facilitated humanitarian projects ranging from a device to help wheelchair users load a canoe or kayak onto a car to adaptive tricycles for land mine victims in Mozambique.

However, Crosby gives all the credit to his students, who select the projects themselves. He says that while he sets the course framework and issues final grades, the students are the true masterminds and heroes.

"It's exciting to me to see how smart our students are and how well they work together," Crosby says. "They're creative. I'm in awe of them, I really am."

The students determine their project at the beginning of the school year, when they select a topic from the pool of ideas Crosby receives from the public and class members. Ideally, Crosby says, each project has a real-life client who can be consulted to help students understand the need.

"That act of providing a product which is designed to help others feels great and is very motivating, knowing that someone is excited to see what the teams create," says Justin Hagelin, an MET senior in Crosby's capstone class. "It gives teams experience dealing with the consumers and users of its product, which is often the hardest obstacle to overcome in a design."

For example, the 2010–11 project idea came from one of the many older, nontraditional students in the class whose wife works at Westgate Manor in Bangor, Maine. At the nursing home, staff members have to crush pills that seniors can't swallow. However, the pill crushers on the market can be difficult to use and can injure nurses' hands, Crosby says.

"The MET capstone projects in particular are often aligned to improve a specific product for handicapped individuals with limited mobility, loss of extremities, or a number of other various products designed to improve the quality of life for members of society," says Ryan Keezer, the student whose wife suggested the pill crushers. "The capstone projects are what the MET program is all about."

"You have to think, 'There must be a better way,'" says Crosby, whose hope is for his students not just to build something for a grade, but to build something that works and has a real-world application.

And if the projects help students gain a greater understanding of the world around them, all the better. For instance, with the 2009–10 tricycles for land mine victims, Crosby says developing and testing the designs helped students put their own struggles in context.

"I think it speaks well of the students to pick something like this," Crosby says of the humanitarian projects, which he notes class members care more about because they have final say on the which topic to choose. "Often, these are underserved people whom the big companies don't cater to."

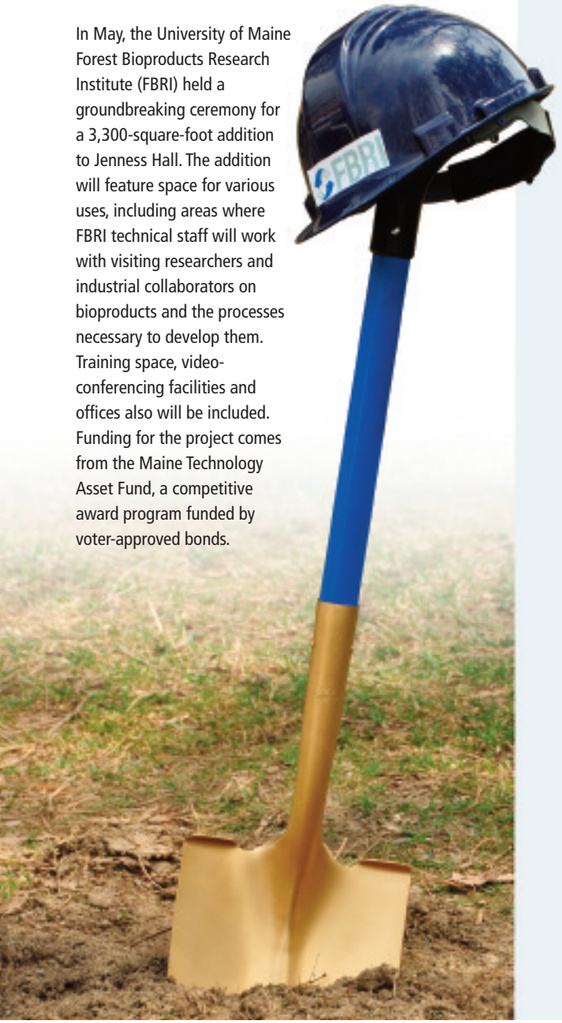
With a $200 budget goal the past two years and no taxpayer money involved, the students rely on donations, and each group does all the work in soliciting its own materials from area businesses.

The students put in around 1,000 hours per team, meeting outside of class as well. Crosby hopes that the projects sum up what they've learned in earlier coursework and emphasize the need for teamwork and ingenuity. Crosby also encourages a bit of competition as well: The winning team gets an A and all are prepared for the global workforce. And designing safe products fosters a concern for what is right, instilling a sense of ethics.

"It's a labor of love," Crosby says. "I know from experience — our students are not quitters. There's a lot of pride here and not much sleep sometimes." ■

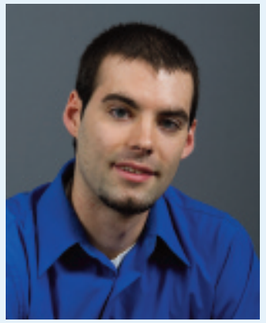
Professor Herb Crosby, right, has taught MET 464 and 465 since 1980, and has facilitated countless humanitarian projects with global implications.

FBRI breaks ground for new facility



In May, the University of Maine Forest Bioproducts Research Institute (FBRI) held a groundbreaking ceremony for a 3,300-square-foot addition to Jenness Hall. The addition will feature space for various uses, including areas where FBRI technical staff will work with visiting researchers and industrial collaborators on bioproducts and the processes necessary to develop them. Training space, video-conferencing facilities and offices also will be included. Funding for the project comes from the Maine Technology Asset Fund, a competitive award program funded by voter-approved bonds.

2011 Outstanding graduating students



Brian McLaughlin
Mechanical Engineering

Brian McLaughlin of Standish, Maine, was named the **2011 Outstanding Graduating Student** in the College of Engineering. McLaughlin majored in mechanical engineering and minored in mathematics. His many honors include the Ralph Sanborn '39 Scholarship, a Top Scholar Award and the Doreen Thibodeau Unsung Hero Award. Since his junior year, he has worked as an assistant in the Rehabilitation & Neuromuscular (ReNeu) Robotics Laboratory of Professor Ashish Deshpande, where he designed, fabricated and built biomechanical models of robotic joints with compliant, humanlike characteristics. In summer 2009, McLaughlin interned as a safety engineer with Pike Industries Inc., in Westbrook, Maine. Last summer, he interned as a design engineer with Mega Industries LLC in Gorham, Maine. On campus, he was the lead engineer of UMaine's Formula SAE Suspension Team, supervising the student engineers responsible for designing, modeling and analyzing the racecar's high-performance components. He has been hired as a design engineer at Pratt & Whitney in North Berwick, Maine.

Jonathan Balentina
Civil Engineering

Jonathan Balentina of Curacao, Netherlands Antilles, was named the **2011 Outstanding Graduating International Student** in the College of Engineering. Balentina majored in civil engineering and was a pitcher on the UMaine Baseball Team. The Scholar-Athlete Award winner was named to the America East Baseball All-Academic Team in 2009, and was a member of Team Maine in 2010. He plans to pursue a graduate degree in civil engineering at UMaine.

SIE merges into a new school

The Department of Spatial Information Science and Engineering (SIE) has merged into a newly created School of Computing and Information Science in the College of Liberal Arts and Science. This represents the next step in the evolution of this department, whose roots go back to the B.S in surveying engineering that was housed in the then Department of Civil Engineering. In the late 1980s, the group split off into its own department.

Over time, its emphasis shifted from traditional surveying and more toward the creation of systems to manage and display spatial information. In 2005, this resulted in the traditional surveying component being spun off into a separate B.S. in surveying engineering technology in the School of Engineering Technology.

The decision to merge SIE into the new school, that also includes computer science, was made after a year-long discussion with faculty and administration. The new school will have strengths in undergraduate and graduate education, combined with a strong focus on research.

Chet Rock, a professor of civil engineering since 1979 who was tapped to be associate dean in 1997, retired May 13.

Mohamad Musavi is now the associate dean of the College of Engineering. Musavi joined the College of Engineering in 1983. He has served as chair of the Department of Electrical and Computer Engineering since 2004.

UMaine lands ADVANCE grant

Karen Horton

A five-year, $3.3 million National Science Foundation ADVANCE grant is funding a new University of Maine initiative to improve institutional conditions disproportionately affecting female faculty in the sciences, technology, engineering, mathematics and the social-behavioral sciences.

Last fall, the grant established the Rising Tide Center, which supports the initiative at UMaine and in the University of Maine System. Karen Horton, associate professor of mechanical engineering technology, served as the center's interim director.

The goal of the center is to increase the number of female faculty members in the STEM disciplines (science, technology, engineering and mathematics) and social-behavioral sciences by defining the practices that attract and support the retention of female faculty, facilitating promotion through the academic ranks and to administrative positions, and providing professional satisfaction.

This past spring, the center announced its first round of grants aimed at fostering the professional development of UMaine female faculty members. Nine grants totaling more than $76,000 were awarded to UMaine faculty members in a range of academic fields in one of four granting categories: research seed, leadership development, unit climate award and climate research.

UMaine has a combined 114 female faculty members teaching in STEM and social-behavioral fields, compared with 284 male faculty members in those areas.

Five UMaine faculty members co-authored the ADVANCE grant: Susan Hunter, UMaine's senior vice president for academic affairs and provost., and a biology professor who is the principal investigator on the project; Amy Fried, associate professor of political science; Susan Gardner, associate professor of higher education; Karen Horton; and Jody Jellison, former professor of molecular plant pathology and director of the School of Biology and Ecology.

This past spring, Ellie Groden, professor of entomology, replaced Jellison on the team and now administers the Rising Tide grants program. Mary Madden, an associate research professor in the Center for Education and Research, was named director of UMaine's ADVANCE Rising Tide Center.

In February, more than 200 students and teachers from three area middle schools were on campus for the University of Maine NANO EXPO, one of four events in the state planned as part of the Making Stuff educational outreach campaign, sponsored by WGBH in Boston and the Nanoscale Informal Science Education Network. Like the Public Broadcasting NOVA program "Making Stuff," the daylong workshop at UMaine focused on materials science, featuring student and faculty researchers from the Biomedical Engineering Advanced Robotics Lab, AEWC Advanced Structures & Composites Center, the Laboratory for Surface Science and Technology, and the Forest Bioproducts Research Institute. Maine was one of 15 sites nationwide selected as outreach centers. The statewide events are funded through a grant to the Maine Discovery Museum on behalf of a 17-member coalition, including the College of Engineering and its departments.

Launching wireless sensors

In California's Mojave Desert, five University of Maine students participated in the April 16 launch of a rocket loaded with wireless sensors they developed.

The students, working under UMaine Associate Professor of Electrical and Computer Engineering Ali Abedi, collaborated on the NASA-funded project with faculty and student researchers at California State University at Long Beach and Garvey Spacecraft Corp. (GSC), a California-based R&D company focusing on cost-effective development of advanced space technologies and launch systems.

The UMaine payload, which was integrated into a rocket known as the Prospector 18B, included sets of wireless sensors that detect acceleration in three dimensions to determine the amount of vibration of the rocket before and during liftoff. The vibration levels are crucial because even the most miniscule amount of vibration before launch could throw a rocket off its intended path and reduce engine performance.

The sensors sent back data to a laptop on the ground during the launch, and also stored data onboard the payload when the sensors went out of range of the laptop. Abedi and his students will hand over their data to Cal State Long Beach, GSC and NASA so those organizations can continue refining their models.

The electrical and computer engineering seniors on the project are all from Maine: Zachary Janosik of Windham, Adam Marsano of Saco, John Murray of Raymond, and Joel Castro of Winslow. Ph.D. student Fred Schwaner of Hebron managed the project this year. In 2009, he participated in a similar project as a UMaine undergraduate.

UMaine's role in the project was funded by a $24,950 grant from NASA via the Maine Space Grant Consortium.

The rocket was equipped with three payloads of UMaine's wireless sensor technology.

Advancing precision manufacturing in Maine

Advancing research, development and commercialization of private sector manufacturing projects in need of technological assistance is the focus of a Maine Technology Institute grant to the University of Maine and University of Southern Maine.

The three-year grant of more than $493,000 from MTI's Cluster Initiative Program will enable precision manufacturers in Maine to advance, expand and increase hiring as they move forward with new project development.

With an estimated $567,000 more in matching contributions, UMaine's Advanced Manufacturing Center (AMC) and USM's Manufacturing Applications Center (MAC), in addition to private sector partners, are launching a $1 million initiative to help businesses overcome technological barriers preventing them from bringing to market hundreds of new products and manufacturing processes.

The two centers help businesses across Maine improve infrastructure and operations through technological and mechanical assistance from faculty researchers and students. The new initiative is based on the recognition that Maine universities and educational institutions have both the capacity and obligation to assist Maine businesses — from financial, business and marketing consulting to engineering-based problem solving in shops, classrooms and laboratories, according to the grant application, co-written by John Belding, director of UMaine's AMC and Mike Wing of USM's MAC.

The funds will be used for personnel and equipment to expand services. Anticipated goals include development of new products and increased manufacturing, project-based learning for Maine's STEM (science, technology, engineering and mathematics) students, new STEM jobs in Maine and improved partnerships.

The AMC advantage

Since 2004, the Advanced Manufacturing Center has helped a diverse range of businesses throughout the state with manufacturing dilemmas and challenges — from creating new medical and scientific tools to improving manufacturing operations and efficiency. AMC Director John Belding cited examples representative of the challenges the center's engineering students, staff and researchers have addressed:

- Helped Falcon Performance Footwear of Auburn, Maine, develop a composite toe protector insert for firefighters' boots.
- Modified an automated wrapping and packaging machine for a small western Maine chocolate confectioner to process in hours what has been taking days.
- Prototyped parts for a new engine that a company wants to market to replace the internal combustion engines in power generation applications.
- Built a prototype pen-sized device to potentially replace tuning forks used by physicians, in addition to other new medical and scientific devices for a variety of clients.
- Designed and built an automated crimping workstation for a small coastal canvas company to improve assembly productivity and product quality. What used to take two hours can now be done in 20 minutes with less waste and improved ergonomics.

The projects "show how we can support economic development and help grow these small companies in Maine," Belding says.

A composite toe protector designed by UMaine engineers for Falcon Performance Footwear in Auburn, Maine.

Krish Thiagarajan

New researcher to support offshore wind, tidal initiatives

Krish Thiagarajan has been appointed as the Alston D. and Ada Lee Correll Presidential Chair in Energy, and professor of mechanical engineering. His expertise in the hydrodynamics of floating structures is essential to UMaine's research in offshore wind and tidal energy.

Thiagarajan received a master's degree in ocean engineering from Memorial University in Newfoundland, Canada, in 1989 and three graduate degrees from the University of Michigan: master's degrees in naval architecture and marine engineering, and in mechanical engineering in 1992, and a Ph.D. in naval architecture and marine engineering in 1993. He has held many positions in academia and industry, and comes to UMaine from the University of Western Australia.

The Presidential Chair was funded by a generous gift from Alston D. "Pete" and Ada Lee Correll. They resided in Old Town, Maine, in the mid-1960s, where Mrs. Correll taught elementary school and Mr. Correll completed double master's degrees in chemical engineering and pulp and paper technology from the University of Maine. Pete Correll went on to become one of the most respected and accomplished paper executives in the country, only recently retiring as chair and CEO of Georgia Pacific. He now heads Atlanta Equity, a venture capital firm in Georgia.

This spring in the College of Engineering:

- Three students in an electrical and computer engineering independent study course developed a mobile application for smart phones to better manage their academic life on campus. The application, freely available through the online Android Market, is an open-source application that allows students and others to view weekly class schedules, class locations, textbook lists and instructor contact information. It provides information on parking, a building map and a faculty/staff directory, which could be particularly helpful to new students and visitors, according to Yifeng Zhu, associate professor of electrical and computer engineering, who taught the class.The students were computer engineering majors Jason Monk of Pittsfield, Maine, and Robert King of Richmond, Maine, and computer science major Jerry Zhu from China. Monk and King are now computer engineering graduate students working as research assistants on projects funded by the National Science Foundation.

- The University of Maine approved three new 18-credit minors for implementation this fall. Students can choose tracks in renewable energy engineering, renewable energy science and technology, and renewable energy economics and policy. There's also an option for a concentration in renewable energy for students pursuing bachelor's degrees in economics. The faculty are from all of the engineering departments, as well as the School of Economics and School of Forest Resources. "The College of Engineering has so much research in renewable energy across a number of fields that it made sense for a curriculum to dovetail into it," says James Passanisi, project coordinator for renewable energy curriculum. "Now students can have a degree with the breadth of broad training in a conventional engineering field and the specificity of the renewable energy minor." The academic curriculum includes laboratory work and summer internships.

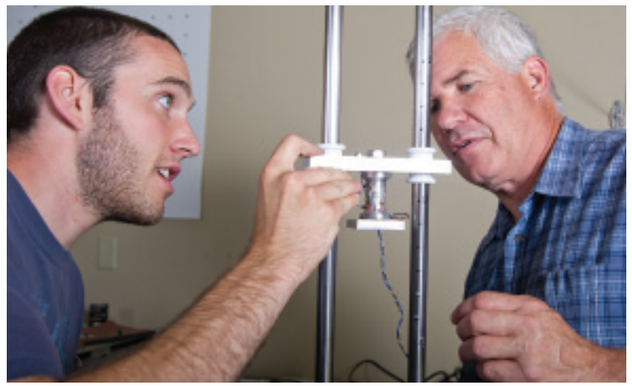
- The Charles Pankow Award for Innovation from the American Society of Civil Engineers (ASCE) was awarded to the AEWC Advanced Structures & Composites Center at the University of Maine for development of the Bridge-in-a-Backpack™. The Pankow Award, one of the engineering profession's highest honors, was presented to AEWC Director Habib Dagher at the ASCE Outstanding Projects and Leaders Awards Gala in Washington D.C., March 31. The Pankow Award was established by ASCE to celebrate collaboration in innovative design, materials or construction-related research and development transferred into practice in a sustainable manner. Bridge-in-a-Backpack™ technology uses carbon fiber reinforced polymer composite arch tubes that serve as superstructure components to efficiently carry bridge design loads. A 70-foot tube can fit in a hockey bag, can be inflated on-site using an air compressor running off a pickup truck, and can be bent to any shape and infused with a resin. It becomes stronger than steel in about three hours.

- Carlton Brown, associate professor of surveying engineering technology, was awarded the 2011 Earle J. Fennell Award by the American Congress on Surveying and Mapping (ACSM). The annual national honor is awarded to one faculty member in the U.S. for distinguished teaching and service to the surveying and mapping profession.

A Bridge-in-a-Backpack™ project in Auburn, Maine.

THE UNIVERSITY OF MAINE
College of Engineering
5796 AMC, Room 200
Orono, Maine 04496-5796

BE A CATALYST FOR INNOVATION **WITH YOUR GIFT TO UMAINE ENGINEERING**



Mechanical engineering technology junior Joe Travaglini, left, and Professor of Mechanical Engineering Vince Caccese

- Support the College of Engineering or your department through **The Fund** (engineering.umaine.edu and then click "Give Now").
- Create an endowed fund in the University of Maine Foundation.
- Leave a legacy through your estate plans.

ENGINEERING
innovating our economic future

For more information, contact Pat Cummings, Director of Development for the College of Engineering (800-671-7085 or 207-581-1155; pat.cummings@umit.maine.edu).

University of Maine College of Engineering
engineering.umaine.edu

5796 AMC, Room 200 • Orono, ME 04469-5796 • Phone: 207-581-2216 • Fax: 207-581-2220

A member of the University of Maine System